

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

MICROBIOLOGY GOALS AND OBJECTIVES

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Microbiology Laboratory
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Length of Rotation:

3 month rotation divided into 1 or 2 month blocks

Overall Goals:

1. Achieve basic competency in microbiology as pertinent to the practice of clinical pathology.
2. Develop skills for basic consultation as regards to testing for the diagnosis of infectious diseases.
3. Correlate results of microbiologic and laboratory testing for infectious diseases with tissue histopathologic findings, when available.
4. Establish close interactions with the Infectious disease team.

Objectives & Expectations:

1. Complete required bench rotations - 12 weeks
 - a. Specialty Testing Center (M-F, 9AM - 5PM)

Specimen Collection & Processing	ID Specimen Processing	Day 1- week 1
Routine Bacteriology	Urine / Miscellaneous Cultures	1 week
	Blood Cultures	1 week
	Respiratory Cultures	1 week
	Anaerobic Cultures	1 week
	Stool & Genital Cultures	1 week
Antimicrobial Susceptibility Testing	Susceptibility Testing and Automated ID	2 weeks
Mycology	Mycology	1 weeks
Parasitology	Parasitology	1 week
Virology	Virology	1 week
Serology & Antigen Detection	Serology & Antigen Detection	1 day
Mycobacteriology	Mycobacteriology-Sac Co PHL	1 day

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

Laboratory Management	Specialist Bench	1 day
MALDI-TOF	Learn Technology & Lab Utilization	2 days
QA/QC	Procedure revision or validation	

2. Perform and complete assigned clinical consultations or microbiology calls
 - a. Requested by technologists, specialists, supervisors or attending on plate rounds or otherwise
 - b. Resident to evaluate consultation, review performed, requested & in progress testing, consult with physician & EMR, review with attending or supervisors when necessary, formulate a decision & communicate back to consulting technologist or involved parties
 - c. Consultations & outcome are to be reviewed on daily, **documented on call log forms (kept in blue call binder), and given to Dr. Romanelli at the end of the current month's rotation**

3. Present at clinical pathology AM conference
 - a. NOTE: this presentation & topic must differ from "Tech case presentation and ID Plate Rounds."

4. Prepare and present 1 "Tech case presentation" during each month of rotation
 - a. Select 1 microbiology or ID related case from benches, plate rounds, surg path or elsewhere
 - b. Format optional (e.g., power point not required) but correlation of clinical case, microbiology testing, treatment required with images or exhibits
 - c. Only 1 resident may present per Tuesday
 - d. Coordinate with supervisors, Nao Thao and other scheduled residents to select exact time and Tuesday during month for presentation (20-30 min., 1-1:30PM)
 - e. Schedule conference room at STC for selected date (Nao Thao)

5. Prepare and present case for ID Plate Rounds during each month of rotation
 - a. Select 1 interesting case from benches or cases requested by ID team
 - b. Prepare demonstrations for teaching purposes (i.e. cultured plates, biochemical tests, susceptibility panels, etc.)
 - c. Format: handout to be given to ID teams during presentation (i.e. powerpoint not required)
 - d. Further instruction on preparation of Plate Rounds will be given by Dr. Romanelli
 - e. Every other Tuesday morning at 9:15-10:30am in the Microbiology Lab at the STC

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

6. Attend Friday morning “Infectious Diseases case conference” (7:45, 6th Floor Davis Tower Conference, Rm. 6704) ≥ 2 times each month on rotation
7. Complete required unknowns, problem sets, case studies and study questions for bench rotations (coordinate with Janet Kashiwada & Carol Fleming)
 - a. Specimen Collection & Processing (20: 10-collection & transport; 10-processing, written)
 - b. Gram stains (10, practical for each month on rotation)
 - c. Bacterial (10, practical)
 - d. Antimicrobial Susceptibility (20: 10-bacterial; 5-fungal; 5-viral, written)
 - e. Mycology (10, practical)
 - f. Parasitology (15: 10 stool / miscellaneous; 5 blood, practical)
 - g. Virology (10, written)
 - h. Serology / Antigen detection (10, written)
 - i. Mycobacteriology (10, written)
8. Complete 1 week of rounds with the ID clinical service during 3rd month of rotation
 - a. Serve as Microbiology Consultant to the ID team during clinical rounds
 - b. Coordinate schedule with Dr. Romanelli
9. Write and publish one case report or review during 2nd & 3rd month on rotation.
 - a. Discuss topics with Dr. Romanelli.

I deleted what was originally #7 on revising SOPs

Core Competencies (as related to microbiology):

Patient Care:

- Residents will become familiar with and display understanding of the essential methods and requirements for collection, transport & processing of clinical patient specimens for microbiologic testing.
- Residents will develop and demonstrate an ability to appropriately interpret routine microbiologic cultures and test results in the context of patient history and clinical information.
- Residents will acquire basic understanding of methods used to ensure quality, accuracy and consistency of clinical microbiologic testing.

Clinical Consultation:

- Residents will become proficient in effective interaction with referring health care professionals to ensure optimal patient care, providing pathology-related consultation to clinical staff as it pertains to individual cases and patients. Specifically, the resident will:

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- Gather essential and accurate information about patients, especially additional data that from other pathology services such as surgical pathology and flow cytometry
- Contact clinicians for additional information on patient history as needed
- Make informed recommendations based on patient information and knowledge of available testing
- Advise health care professionals on the spectrum and clinical appropriateness of clinical microbiology tests for a particular disease or health concern
- Offer education and consultation services in clinical microbiology to health care providers
- Contact health care providers with results of time-critical assays

Medical Knowledge:

- Residents will display and develop a working fund of knowledge related to infectious and non-infectious medical disease as relates to evaluation and performance of microbiologic testing.
- Residents will become proficient in the technical, clinical, analytical, and interpretive aspects of clinical microbiological testing done in the laboratory.
- Residents will develop and demonstrate an understanding of the epidemiology of common and uncommon infectious diseases stratified by age and risk factor for use in selection and interpretation of microbiologic testing.
- Residents will acquire and display appropriate understanding of the significance of routine bacterial, fungal, viral, and parasitic isolates or results in relation to specimen source, collection method, patient age and risk factors and other clinical and laboratory data.
- Residents will acquire and develop a basic understanding of the relative strengths and weaknesses (e.g., sensitivity, specificity, etc.) of available microbiologic tests necessary to advise clinicians and staffs in test selection and interpretation.
- Residents will learn the basic principles for the isolation and identification of the common medically important bacteria, mycobacterial, fungi, parasites and viruses.
- Residents will learn the basic principles for performing antimicrobial susceptibility testing.
- Residents will become familiar with the common mechanisms for antimicrobial resistance observed in medically important bacterial agents. Be able to recognize common antimicrobial resistance phenotypes.
- Residents will become proficient in reading and interpreting Gram stains of a variety of clinical materials.
- Residents will learn the methods and applications of molecular testing for infectious diseases.
- Residents will learn the basic principles of serologic testing for infectious diseases including antigen and antibody detection methods.

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- Residents will become familiar with general concepts of quality control in the clinical microbiology laboratory.
- Residents will become familiar with general concepts of hospital epidemiology and infection control.
- Residents will become familiar with the clinical microbiology tests, and general clinical findings for some common infectious diseases, such as sepsis, meningitis, pneumonia, urinary tract infection and wound infection.

Practice Based Learning & Improvement:

- Residents will demonstrate and develop an ability to investigate patient histories, clinical, radiologic & laboratory findings as applied to the selection and interpretation of microbiologic testing.
- Residents will incorporate review of traditional resources (e.g., textbooks, conference materials) with current and latest information obtained from journals or peer reviewed electronic databases into their evaluation of test results and clinical consultations. Importantly, the resident will display an understanding of the potential differences in the quality and accuracy of data obtained from expert texts and peer reviewed works versus non-academic resources (e.g., internet).
- Residents will demonstrate an ability to incorporate feedback obtained on plate rounds or evaluations into subsequent performance including ability to interpret test results or obtain data when reviewing EMR or discussing patient with treating physician.
- Residents will display a willingness and ability to assist in the education and learning of peers and non-medical (e.g., laboratory) staffs).

Interpersonal & Communication Skills:

- Residents will develop and demonstrate an ability to effectively communicate with physicians, medical & laboratory staff in order to advise & resolve issues of microbiologic test selection, performance and result interpretation.
- Residents will demonstrate an ability to document clinical consultations and test evaluations in a legible and timely manner via microbiology call log sheets.
- Residents will communicate with laboratory and technical support staff and other individuals with respect and sensitivity. Positive, constructive interactions with laboratory and technical support staff (medical technologists) are necessary and will be monitored.

Professionalism:

A professional demeanor must be maintained at all times when dealing with support staff, colleagues and clinical staff.

- Residents will demonstrate an appreciation for and adherence to accepted standards of medical responsibilities and ethics including respect, timeliness, accountability, and completion of assigned tasks.

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- Residents will show dependability and punctuality with respect to responsibilities, bench rotations and clinical activities.

Systems Based Practice:

- Residents will learn about and incorporate an understanding of the impact of microbiologic testing and reported results on physician decision making including diagnoses, subsequent patient evaluation and treatment.
- Residents will learn about the types and extent of services, techniques and tests available and community based, academic and referral level laboratories.
- Residents will see and incorporate into their practice an appreciation for how the extent of evaluation and method of microbiologic testing may impact laboratory, patient and healthcare costs.
- Residents will learn and demonstrate an ability to combine microbiologic and clinical data into their evaluation of surgical pathology specimen evaluations.

Regularly integrate clinical microbiology testing results with clinical history and information from other studies.

- b. Provide guidance to clinicians to ensure that clinical microbiology testing is used and integrated into patient care in an appropriate and cost-efficient manner
- c. Learn how laboratory management and activities affect other health care professionals, organizations, and society
- d. Help to facilitate effective and efficient laboratory workflow practices
- e. Become familiar with laboratory billing methods, the use of CPT codes, diagnostic codes, and health insurance and reimbursement issues (through department didactic lecture series)
- f. Learn about new assay development and validation (through department didactic lecture series)
- g. Participate in programs of quality control, quality assurance, and quality improvement
- h. Understand the importance of CLIA '88 and mechanisms for laboratory accreditation

including proficiency testing and the CAP inspection process. Residents will be expected to perform a mock CAP inspection of the Clinical Microbiology Laboratory to meet the requirements for completing the rotation.

Objectives / Competencies by PGY:

PGY1

- Participate in lab rounds.
- Consult with clinicians & EMR to obtain clinical & other laboratory data for application to active cultures and microbiology testing.
- Complete appropriate quizzes / unknowns for benches, attend ID conferences, give expected presentations.
- Acquire working knowledge of appropriate common and uncommon specimen types and methods of collection and transport for routine microbiologic testing.

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- Develop and be able to demonstrate knowledge of various microbiologic media used for routine and specialized cultures (e.g., BAP, CHOC, MAC, CNA, MTM, etc.)
- Be able to list the ingredients / reagents and principal involved in routine selective or differential culture media or routine biochemical tests (e.g., catalase, latex agglutination, Optochin, bile solubility, coagulase, TSI, Mac, etc.)
- Know and be able to recognize or describe the Gram stain and colony morphologies as well as the major biochemical reactions for routine pathogenic and non-pathogenic bacterial species.
- Develop a working knowledge of the normal colonizing flora for each of the major anatomic sites.
- Be able to describe the difference between semi-quantitative and quantitative cultures and give examples of each.
- Interpret urine culture results upon the basis of quantitation and ID and correlate with UA when appropriate.
- Demonstrate knowledge of major urinary tract pathogens.

PGY2

- Participate in lab rounds.
- Consult with clinicians & EMR to obtain clinical & other laboratory data for application to active cultures and microbiology testing.
- Complete appropriate quizzes / unknowns for benches, attend ID conferences, give expected presentations.
- Be able to describe the impact of various parameters on the sensitivity and accuracy of blood cultures: site of collection, number of blood cultures submitted, thorough skin antisepsis, volume of blood collected per bottle or set, prior administration of antibiotics, submission of aerobic vs. anaerobic vs. set.
- Be able to discuss and apply common criteria to distinguish the significance of bacteria isolated in blood culture.
- Demonstrate knowledge of common & uncommon causes of bacteremia, endocarditis, catheter related BSI, contamination, polymicrobial bacteremia.
- Be able to list the bacterial, fungal and mycobacterial organisms for which routine bacterial blood cultures may not or are not sufficient for detection.
- Be able to list alternative non-culture based tests available for the diagnosis of common and unusual blood stream infections.
- Be able to discuss the concept and potential importance of large volume culture as applied to culture of blood and body fluids in some disease states.
- Understand and be able to discuss the criteria used for screening sputum and similar non bronchoscopic respiratory specimens for acceptability for culture.
- Be able to list the major upper and lower respiratory pathogens causing URI, sinusitis / OM, pharyngitis, bronchopneumonia.
- Be able to discuss the use of Gram stain, semi quantitation & ID to distinguish colonization with potential pathogens vs. likely association with acute infection for the above infectious syndromes.

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- Know the major CF pathogens associated with progression of pulmonary disease and media used for their detection.
- Be able to discuss the strengths and weaknesses of various specimen types (swabs, aspirate, tissue biopsy) in the diagnosis of wound infections, abscesses, etc.
- Be able to discuss the use and limitations of broth cultures.
- Demonstrate a knowledge of the major organisms associated with wounds, cellulitides, abscesses, etc. and their likely contribution to infection.
- Be able to discuss anaerobic cultures including appropriate and inappropriate specimen types, atmosphere, types of infections associated with anaerobes, transport of specimens for anaerobic culture and the difference between obligate aerobes, anaerobes and facultative organisms.
- Be able to list the bacteria associated with the following CNS infections: bacterial meningitis stratified by age group, shunt or device associated CNS infection, brain abscess.
- Be able to list the other clinical and laboratory data of assistance in making CNS infectious diagnoses.
- Be able to list the causes of infectious gastroenteritis, their relative frequencies and the role / indications for bacterial culture.
- Be able to describe the composition of stool transport media and its purpose (Cary Blair).
- Be able to list the bacteria sought and detected by routine stool cultures.
- List the agents not detected by routine stool cultures and the methods available (e.g., culture or other) for their detection.
- Be able to list the use, composition and interpretation of the media used for routine stool, campylobacter, yersinia & vibrio cultures.
- List the main causes of genital infections / STI's and the role of bacterial culture in their detection.
- Know & be able to discuss the methods / media used to detect or enhance the detection of N gonorrhoeae and GBS.
- Be able to discuss the strengths and weaknesses of the various methods to diagnose BV.
- Discuss the relative performance of culture for GC or Chlamydia vs. NAAT.

PGY3

- Participate in and occasionally lead lab rounds.
- Consult with clinicians & EMR to obtain clinical & other laboratory data for application to active cultures and microbiology testing.
- Complete appropriate quizzes / unknowns for benches, attend ID conferences, give expected presentations.
- Be able to list the main antibiotic groups, representative drugs in each group, their mechanisms of action, and spectra of activity.
- Become familiar and be able to describe the performance and relative strengths & weaknesses of the following methods of AST: disk diffusion, broth microdilution, Etest, automated susceptibility testing.

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- Know the methods available & used routinely to screen and or confirm the presence of MRSA, VISA, VRE, ESBL, inducible clindamycin resistance, B lactamase, +/- ampC, heteroVISA.
- Be able to discuss the impact of phase of bacterial growth, inoculum, media, atmosphere & temp of incubation, time of reading, fastidious bacteria (including some viridans Streps, NVS (Abiotrophia, Granulicatella), slow growing bacteria, anaerobes) & antibiotic on accuracy of susceptibility testing.
- Discuss definitions and use of very major error, major error & minor errors in the assessment and comparison of performance of susceptibility testing method with reference method.
- Be familiar with the CLSI guidelines for performance and interpretation of susceptibility testing.
- Be able to discuss the selection of antibiotic therapy by site of infection & the role of antibiotic penetration, distribution, adsorption, PK, PD in these decisions.
- Review the UCDMC antibiogram & discuss the importance and use of local bacterial susceptibility data (antibiogram).
- Know the colony & corn meal morphology and key biochemical differences for *C. albicans*, *C. glabrata*, *Cryptococcus*, *Malassezia* spp.
- Know the mechanism of action and spectrum of activity for each of the major antifungal drugs
- Know *Candida* spp. with intrinsic or reduced susceptibility to azoles, amphotericin, and echinocandins
- Be able to list main the drugs used to treat *Aspergillus*, *Fusarium*, *Pseudallescheria boydii*, and *Zygomycetes* and the main resistance issues between these groups
- Discuss the potential clinical significance of isolation of various genera of mold or yeast from mucosal or respiratory sites including sinus, sputum, BAL, vagina, tissue or sterile body site
- Be able to explain the different ways to diagnose invasive mold infection and the relative strengths and weaknesses of each method
- Know the macroscopic and microscopic morphology (tease or scotch tape prep +/- histopath) for the following: *Aspergillus* sp., *Fusarium*, *P. boydii*, Dermatophytes, Dimorphic fungi, *Zygomycetes*, Major dematiaceous molds.
- Know the major dimorphic molds, their geographic distributions, spectra of disease, methods of diagnosis, tissue appearance and methods for laboratory ID
- Be familiar with the following clinical entities or terms: colonization, superficial, invasion, actinomycosis, mucormycosis vs. zygomycosis, botryomycosis, mycotic aneurysm, Madura foot, black & white grain mycetoma, eumycotic mycetoma vs. actinomycotic mycetoma, chromoblastomycosis, lobomycosis
- Know which fungi can be detected in routine blood cultures, which require "fungal" blood cultures and which are not reliably detected from culture of blood by either method
- Know the major clinical syndromes associated with aerobic actinomycetes, esp. *Nocardia* and distinguish "actinomycetes" from "aerobic actinomycetes"

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- Know the limitations of fungal ID from histopathologic sections and stains
- Be able to recognize and identify the laboratory and, when appropriate, tissue morphology for the following: Pathogenic and non-pathogenic protozoa, Helminthes, Tissue parasites, Ectoparasites, Blood parasites
- Be able to describe the appropriate collection (frequency, etc.) fixation, transport & processing of stool for O&P, DFA, EIA.
- Be able to list and discuss the relative strengths and weaknesses of the various methods that may be used for the diagnosis of gastrointestinal parasites including sensitivity, specificity and availability. Know which parasites will and will not be detected by each method and the relative sensitivities for various parasites and disease states (Microscopic O&P (wet mount, iodine prep, trichrome), modified AFB, Calcofluor, Gram chromotrope, Immunoassays for antigen detection, Serology, PCR)
- Be able to describe the timing and methods for collection and processing of blood for the detection of malaria, trypanosomes & microfilariae
- Be able to state the preferred specimen and test method and alternatives for the detection of each of the following: Giardia, Cryptosporidium, Entamoeba histolytica/dispar (Intestinal vs. liver abscess), Cyclospora, Isospora, Microsporidia, Strongyloides (intestinal vs. disseminated), Echinococcus, Pinworms, Malaria, Microfilariae, Trypanosomes
- Be able to explain the difference between E. histolytica and E. dispar and how these may be distinguished in clinical specimens
- Be able to discuss the significance of E. coli, D. fragilis, B. hominis from stool
- Know the epidemiology / causes of infectious gastroenteritis in the US and in travelers from underdeveloped regions including the relative proportions of disease that are caused by viruses, bacteria and parasites
- Know which parasites are associated with Eosinophilia
- Be able to list and discuss the strengths and weaknesses of all the potential ways (methods) to detect viruses
- Be able to discuss the associated disease states, methods available for the detection and relative strengths and weaknesses of each test method (e.g., DFA vs Culture vs PCR vs Serology) for the following viruses: HSV, VZV, CMV, HHV-6, EBV, HHV-8, Adenoviruses, HPV, Polyoma viruses, Parvoviruses, Hepadnaviruses (HBV), Influenza, Parainfluenza, RSV, Measles, Mumps, hMPV, Coronaviruses, SARS, Coxsackieviruses, Echoviruses, Enteroviruses, Polioviruses, Rhinoviruses, HAV, Norovirus, Rotavirus, WNV, St Louis EV, HCV, HTLV, HIV, Hanta, Rabies
- Know the common types of traditional cell types used for culture of Herpesviruses, paramyxoviruses and enteroviruses.
- Discuss the viruses that can be detected in culture and which ones are not generally cultivable.
- Be able to discuss the significance of a positive qualitative PCR result for common Herpesviruses from blood, tissue, or CSF
- Be able to list the methods available to help interpret the significance of a positive qualitative PCR for herpesvirus from the above specimen types

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- Know the drugs available to treat Influenza and herpesviruses and their mechanisms of action
- Know the common H & N types for seasonal vs. potential pandemic flu strains (avian, etc)
- Be able to explain the difference between antigenic shift and drift in the epidemiology of Influenza
- Understand the reasons why animal including avian strains may have limited ability to be transmitted from human to human
- Discuss the theoretical issues related to detection of pandemic influenza by current laboratory assays.
- Know the common viral causes of upper and lower respiratory tract disease, CNS disease, GI infections, STI's
- Know the differences between HSV 1 & 2 relative to transmission, typical and emerging locations of primary lesions and manifestations of meningitis
- Know the groups and viruses known as the "hemorrhagic fever viruses"

PGY4

- Participate in and occasionally lead lab rounds.
- Consult with clinicians & EMR to obtain clinical & other laboratory data for application to active cultures and microbiology testing.
- Complete appropriate quizzes / unknowns for benches, attend ID conferences, review SOP.
- Be familiar with the diseases for which serology is a major component or the only means of diagnosis (HIV, HAV, HBV, HCV, WNV, Hanta, Lyme, Poststreptococcal disease (ASO, Dnase B), Brucellosis, C. burnetti, Bartonella, C. pneumoniae, M. pneumoniae, Syphilis (T. pallidum), Dimorphic molds, Strongyloides, E. histolytica, LGV serovars of C. trachomatis, HSV, EBV, CMV, HHV-6
- Be able to describe the difference between EIA, western blot & IFA
- Know the criteria for calling an HIV or Lyme WB positive or negative
- Discuss the significance and follow up options for an indeterminate HIV WB
- Know the role and current indications for RIBA testing in the diagnosis of HCV
- Know the sequence of development of antibodies and / or antigens in EBV, HBV, HCV
- Know the timing of detection of viremia, p24 antigenemia and development of antibodies for HIV. Know the meaning and approximate lengths of the "window period" depending on the type of HIV test being used for diagnosis.
- Know how to diagnose HIV and Syphilis in newborns
- Discuss the testing issues and potential follow up for pregnant females with positive Toxoplasma IgM
- Discuss the value of routine torch testing
- Know the bacteria and fungi for which antigen detection is available from urine and the relative performance of this method vs. other methods (e.g., serology, culture)

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- Be familiar with the common forms of disease, patient populations at risk, growth rate, pigmentation and key biochemical features for the common / significant Mycobacteria.
- Know how & why the kinyoun and auramine orange stains work and why these are relatively specific for Mycobacteria
- Know what MTB looks like on smears and in culture
- Be able to discuss the different media types used in the detection of Mycobacteria and both their nutritional & inhibitory components
- Be able to discuss the steps and importance of processing and decontamination of specimens for prior to stain and culture for Mycobacteria
- Be able to discuss the relative performance of culture vs. current molecular tests for direct detection of MTB from respiratory and CSF samples and the molecular probes used for rapid confirmation of ID from positive culture
- Know the approximate time to detection for MTB, slow growers (including MAI) and rapid growers from broth and solid media
- Know the drugs used to treat MTB, MAI, and the rapidly growing mycobacteria
- Be familiar with the differences between the PPD and the interferon gamma release assays, the processing limitations associated with the later and the potential reasons why these assays may replace the PPD in the future
- Identify one basic procedure (SOP) in need of review and complete revision or draft during this bench rotation (see above).
- Be able to discuss the potential impact that differences in volume, temperature or delay in transport, type of specimen or transport media may have on the value or yield of microbiology testing.
- Be able to list at least 3-5 ways in which sensitivity of culture, accuracy of biochemical tests, ID, susceptibility, & overall culture results are monitored and maintained both immediately and over time.
- Discuss the workflow demands in the microbiology lab related to specimen processing and timeliness of results and the potential clinical impacts associated with lack of 24 hour, evening, or weekend coverage.
- Discuss the use of critical calls and the importance of time to results in various microbiologic tests.
- Discuss the daily, weekly and monthly QC performed in the micro lab with a specialist or designee.
- Discuss the importance of equipment maintenance and checks for temperature, CO2 or anaerobic environment, media sterility, BSC function, etc.
- Be able to discuss some of the issues related to quality control regarding detection of organisms from real clinical samples vs. QC bugs and to the detection and testing of living organisms in general
- Discuss some of the unique issues related to PT for microbiology and in particular parasitology.
- Discuss some of the unique challenges associated with maintaining proficiency of technical staffs in microbiology and how this is changing with advent of automated instruments

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- Be able to review existing procedure & relevant resources and literature to update and synthesize SOP that is current and appropriate for laboratory & clinical practice

Objectives by Bench / Area:

ID Specimen Processing	<ol style="list-style-type: none"> 1. Complete the quiz / unknowns for this bench (Specimen processing). 2. Understand basic requirements for collection and transport of specimens for microbiologic testing. <ol style="list-style-type: none"> a. Bacterial aerobes b. Bacterial anaerobes c. Stool & urine cultures (transport media & why) d. Blood cultures e. Fungal cultures f. AFB cultures g. Viral cultures h. Parasitology 3. Understand impact of transport time & temperature on specimen viability and culture results 4. Know what sources and types of transport are appropriate and inappropriate for subsequent anaerobic culture 5. Know about swab specimens & AFB or mycology cultures 6. Recognize, know general purpose & composition for Boric acid transport media, cary blair, amies, regan lowe, anaerobic transport media, 2 part PVA/formalin stool kits 7. Recognize complexity of testing options and differences between major available tests 8. Importance of closed shoes, appropriate clothing, PPE in minimizing risk of laboratory exposures. 9. Types & function of Class I & II BSC, differences between BSL 1- 4 10. Major causes of laboratory acquired infections 11. Use of sterile technique, PPE & Class II BSC to maintain integrity of clinical samples and minimize risk to staff of laboratory acquired infection. 12. Appropriate use and preparation of direct examination materials (e.g., direct or concentrated stained smears). 13. Use and selection of routine nutritive (non-selective), enriched, selective, differential and specialized media in plating and evaluation of routine specimens. 14. Appropriate use of enrichment or selective broth media (Thio, GN broth). 15. Process and correctly inoculate media for each of the following specimens ≥ urine, sputum (or ETA), blood culture, routine swab 16. Observe, process or discuss processing for BAL, tissue biopsy, bone, hardware, catheter tips, anaerobic cultures, fungal cultures, viral cultures, AFB cultures
Bacteriology General	<ol style="list-style-type: none"> 1. Complete the 2 quizzes / unknowns for the bacterial benches (Gram

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- stains, bacterial) sometime during these weeks.
2. Know composition and indication for 4 major incubation atmospheres
 - a. ambient
 - b. CO₂ enriched
 - c. microaerophilic
 - d. anaerobic
 3. Know & explain use of different incubation temperatures
 - a. 35-37° C
 - b. 25-30° C
 - c. 4-8° C
 - d. 42° C
 4. Know purpose and components of the following stains
 - a. Gram
 - b. Kinyoun
 - c. modified AFB
 - d. India ink
 - e. Acridine orange
 - f. Auramine rhodamine
 5. Know routine criteria for smear semi quantitation of cells & bacteria and sputum acceptability
 6. Know Gram stain, typical colony morphology (SBA, choc, Mac) key biochemical & antibiograms (S & R) for the following:
 - a. Staphylococcus (CoNS, MSSA, MRSA)
 - b. Streptococci
 - i. S. pneumo
 - ii. Beta hemolytic Strep (GAS, GBS, etc.)
 - iii. Viridans Streptococci
 - c. Enterococcus
 - d. Abiotrophia, Granulicatella, Peptostreptococcus
 - e. Bacillus, Listeria, Corynebacterium (diphtheroids), Lactobacillus, Erisepylotrix, Propionibacterium, Clostridium, Actinomyces
 - f. Haemophilus, Francisella, Brucella, Bordetella, Legionella
 - g. Neisseria, Moraxella, Acinetobacter
 - h. Enteric GNR, NFGNR
 - i. Fusobacterium, Capnocytophaga, Bacteroides, GN anaerobes
 - j. Treponema, Leptospira
 - k. Mycoplasma, Chlamydia
 - l. Mycobacteria
 - m. Nocardia, other aerobic actinomycetes
 7. Know the key components and uses for the following media
 - a. SBA, Chocolate, Mac, Rose (CNA), Brucella
 - b. Mannitol salt agar, BCSA, TCBS, CIN
 - c. Regan Lowe, BCYE, Cysteine tellurite, MTM, NYC, Hektoen Enteric, thioglycolate broth, loeffler's
 8. Know major bacteria +/- fungi in each category
 - a. obligate aerobes

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

	<ul style="list-style-type: none"> b. aerobes / facultative anaerobes c. anaerobes / obligate anaerobes d. Gram positive cocci e. Gram positive rods f. Gram negative cocci / diplococci g. Gram negative rods (typical) h. tiny / pleomorphic Gram negatives i. aerobic actinomycetes vs. actinomyces j. enteric GNR k. NFGNR l. VAPP organisms (Oxidase + glucose fermenters or curved GNR) m. Lactose fermenting GNR n. Non-Lactose fermenting GNR o. Category A & B BT agents p. skin, oral, GI, GU flora <p>9. Know & be able to explain key components & use of each of the following. Perform each $\geq 1-5$ times.</p> <ul style="list-style-type: none"> a. catalase b. staph latex agglutination c. tube coagulase d. bile solubility e. optochin disk f. Vancomycin disk g. SBA hemolysis interpretation h. Mac interpretation i. TSI j. oxidase reaction k. Hektoen enteric l. Gram stain <p>10. Correlate patient age, source, direct gram stain results & growth in culture +/- clinical history $\geq 10-40$ times.</p>
Urine Cultures	<ul style="list-style-type: none"> 1. Read SOP 2. Understand use of quantitation in the interpretation of urine cultures & relationship to method of collection & transport time 3. Know colony count quantities considered significant for CC, Cath & suprapubic specimens 4. Know 3-5 main UTI pathogens 5. Know main perineal contaminants 6. Correlate UA results with Culture results ≥ 5 times
CSF / Miscellaneous Cultures	<ul style="list-style-type: none"> 1. Read SOP 2. Know cell count criteria for traditional types of meningitis 3. Know main causes of bacterial meningitis in neonates, young children, adults, elderly & shunt / hardware associated CNS infections 4. Discuss impact of Haemophilus influenzae type B vaccination and GBS screening on epidemiology of bacterial meningitis 5. Be able to explain the source for invasive infections due to GBS, H

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

	<p>influenzae, <i>S. pneumoniae</i>, <i>N. meningitidis</i>, Group A Strep, <i>S. aureus</i></p> <ol style="list-style-type: none"> 6. Know why broth culture is included with CNS shunt specimens but how results of broth may also be misleading 7. Correlate direct gram stain with wound or swab culture results for 5-10 cultures 8. Give examples of classically monomicrobial and polymicrobial skin & wound infections. 9. Discuss the significance of CoNS, Yeast, corynebacteria, +/- Enterococcus or Enteric GNR from swab wound cultures 10. Discuss the importance of distinguishing swab specimens from tissue or operatively collected specimens 11. Discuss the origin, significance of biofilms 12. Know what sites are appropriate in screening for <i>S. aureus</i> 13. Know or read about the source of most invasive <i>S. aureus</i> infections 14. Know / discuss the composition of the skin flora in community and hospitalized patients
Blood Cultures	<ol style="list-style-type: none"> 1. Read SOP 2. Be familiar with blood culture instrumentation, collection, detection of positive growth 3. List potential causes for blood bottles that flag + but are – on gram stain 4. List potential causes for blood bottles that are + by gram stain but fail to grow on solid media 5. Understand & be able to explain the theoretical difference b/w pediatric & adult blood cultures 6. Distinguish clinical scenarios and proportion of blood cultures that are positive in transient, intermittent and continuous bacteremia 7. Explain appropriate number and frequency for blood culture submission 8. Explain role of volume in blood culture 9. Explain why it is important to track contamination rates 10. Explain the relationship between blood culture and intravascular catheter cultures 11. Define a blood culture set, and discuss importance of # bottles positive, time to positivity, site of collection (e.g., peripheral venipuncture vs. intravascular line) 12. Explain the methods modern blood cultures use to minimize the impact of antibiotics 13. List the causes for polymicrobial blood cultures 14. Explain the purpose for inclusion of anaerobic bottles 15. Explain the use and mechanism of the acridine orange stain 16. Be able to discuss the potential significance of the following when isolated from 1 vs. multiple blood culture sets: <ol style="list-style-type: none"> a. CoNS, <i>S. aureus</i>, <i>S. lugdunensis</i> b. <i>Enterococcus sp.</i>, <i>S. pneumoniae</i>, Viridans Streptococci c. <i>Candida spp.</i> d. Enteric GNR e. <i>Neisseria meningitidis</i>

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

	<p>f. <i>Propionibacterium acnes</i>, <i>Corynebacteria</i>, <i>Bacillus spp.</i></p> <p>17. Explain the potential & preferred method(s) for detection of the following:</p> <ol style="list-style-type: none"> HACEK organisms <i>Bacillus anthracis</i> <i>Brucella spp.</i>, <i>Franciscella tularensis</i>, <i>Coxiella burnetti</i> <i>Neisseria meningitidis</i>, <i>Streptobacillus moniliformis</i> <i>Bartonella spp.</i> <i>Legionella spp.</i>, Leptospirosis <i>Candida spp.</i>, <i>Cryptococcus spp.</i>, <i>Malassezia furfur</i> Dimorphic fungi Zygomycetes, Hyalohypomycetes (<i>Aspergillus</i>, <i>Fusarium</i>, etc.) Mycobacteria <p>18. Perform & interpret Gram stain (5)</p> <p>19. Review patient history & correlate with blood culture & other culture results $\geq 5-10$ times</p> <p>20. Know & discuss the common causes of catheter related bloodstream infections (CR-BSI) & the role of biofilms</p> <p>21. Be able to explain the two major categorical methods for diagnosis of CR-BSI</p> <ol style="list-style-type: none"> without removal of catheter with removal of catheter
Respiratory Cultures	<ol style="list-style-type: none"> Read 3 main SOP's Know media inoculated for routine respiratory, CF culture Know major causes of community acquired pneumonia (CAP), nosocomial or ventilator associated pneumonia (VAP), CF pathogens, Know major causes of upper respiratory tract disease, pharyngitis (viral & bacterial), laryngotracheobronchitis, bronchitis, respiratory bronchiolitis Explain significance of isolation of mold or yeast from various respiratory sites Know major components of OP flora & frequencies at which potential pathogens may also be part of resident or transient OP flora Perform, observe or read about the following <ol style="list-style-type: none"> ID of <i>Haemophilus</i> (X&V, etc.) ID of <i>P aeruginosa</i>, <i>Burkholderia cepacia</i>, <i>S. maltophilia</i>, <i>Acinetobacter</i> Be able to describe key phenotypic ID features for <i>P aeruginosa</i> vs. Enteric GNR Know criteria and be able to explain reason for sputum rejection Explain why there are no rejection criteria for CF cultures & why throat or cough swabs are occasionally accepted for these cultures Correlate Gram stain with patient age, source, clinical history & culture results $\geq 5-10$ times
Anaerobic Cultures	<ol style="list-style-type: none"> Read SOP Know what sources and types of transport are appropriate and inappropriate for subsequent anaerobic culture

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

	<ol style="list-style-type: none"> 3. Be able to discuss the major types and locations of anaerobes as components of the normal flora 4. Be able to list the major categories of infections that may or are likely to include anaerobes 5. Explain the components of routine anaerobic atmosphere and the use of pre-reduced media 6. Explain the two main reasons proposed why aerobic environments may be toxic to anaerobes 7. Explain the clinical significance of anaerobes in pure or mixed infections 8. Explain why discordance between the number of bacterial morphologies observed on Gram stain and the number detected in culture occurs 9. Discuss the pro's and con's of limiting the number of colony morphologies or isolates specifically identified from wound or anaerobic cultures 10. Discuss how the extent of workup might vary between superficial or swab specimens and invasively or operatively collected specimens 11. Be able to discuss how the direct Gram stain may be used to assess the quality and significance of wound or anaerobic cultures 12. Explain how aerotolerance testing is used to verify category of organism prior to attempting identification 13. Know major Gram positive and negative anaerobes of clinical significance, drugs used to treat anaerobic infections and major patterns of resistance among common anaerobes 14. correlate Patient age, source, Direct Gram stain, culture and clinical history for ≥ 5 cultures
<p>Stool & Genital Cultures (+Legionella, Bordetella, sterility cultures)</p>	<ol style="list-style-type: none"> 1. Read SOP's 2. Know major causes of invasive bacterial gastroenteritis and more common causes of infectious viral or bacterial gastroenteritis that are not routinely sought or detected 3. Know use and key components of Sorbitol Mac, Hektoen Enteric, TCBS, CIN, GN broth, BCYE, Regan Lowe, MTM, NYC, TSI, CTA sugars 4. Know purpose and organisms sought by "Oxidase sweep" of primary zone on stool cultures 5. Know rejection criteria for routine bacterial stool cultures for hospitalized patients 6. Know composition of microaerophilic atmosphere and ID features for Campy, Vibrio, E coli 0157, Salm, Shigella 7. Be able to discuss etiology and methods to diagnose BV 8. Know major and uncommon STD's, best and traditional tests used for diagnosis, morphology on smear or culture (when appropriate) and media 9. Know Neisseria spp. and non-neisseria spp. that will grow on MTM or NYC 10. Know and explain significance for confirmatory testing for ID of N. gonorrhoeae or N. meningitidis 11. Discuss relative performance and indications of culture vs. nucleic

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

	<p>amplified method for detection of NGC or Chlamydia</p> <p>12. Know major types of illness caused by Legionella and Bordetella spp.</p> <p>13. Discuss the relative strengths of DFA, Urinary Ag detection, culture and PCR methods for detection of Legionella infection</p> <p>14. Discuss relative performance of DFA vs. Culture vs. PCR for Bordetella</p> <p>15. Discuss differences between clinical disease due to Bordetella in unvaccinated infants or kids and remotely vaccinated adults and the significance of waning immunity or unvaccinated populations in the spread of Bordetella</p> <p>16. Know what test methods are available to diagnose disease due to Chlamydia pneumoniae or Mycoplasma pneumoniae</p> <p>17. Be able to explain the difference between traditional bacterial or lobar pneumonia and “atypical” pneumonia and which antibiotics are necessary to treat Chlamydia, Mycoplasma, Legionella, Bordetella, etc.</p>
<p>Antimicrobial Susceptibility Testing and Automated ID</p>	<ol style="list-style-type: none"> 1. Complete the 1 quiz / unknowns for this bench (Antimicrobial susceptibility testing). 2. Review and know mechanism of action, spectrum of activity & common mechanisms of resistance for major antibiotic classes <ol style="list-style-type: none"> a. Cell wall synthesis inhibitors <ol style="list-style-type: none"> i. Penicillins, beta lactams, cephalosporins, carbapenems ii. Glycopeptides b. Cell membrane disruption <ol style="list-style-type: none"> i. Cyclic lipopeptides (Daptomycin) ii. Lipopeptides (Polymyxin B, Colistin) c. Protein synthesis inhibitors <ol style="list-style-type: none"> i. Tetracyclines ii. Macrolides, lincosamides iii. Aminoglycosides iv. Oxazolidinones d. DNA synthesis inhibitors (promote stably cleaved DNA) <ol style="list-style-type: none"> i. Quinolones, fluoroquinolones, 8-Methoxy fluoroquinolones e. DNA-dependent RNA polymerase inhibitors (Rifamycins) f. Folate synthesis inhibitors g. Others <ol style="list-style-type: none"> i. Chloramphenicol ii. Nitrofurantoin iii. Metronidazole iv. Isoniazid (mycolic acid synthesis inhibitor) v. Ethambutol 3. Know difference between concentration dependent and time dependent killing and which drugs behave which way 4. Know which drugs are generally bactericidal and which are bacteristatic 5. Know the major drugs that may potentially be used to treat each of the following <ol style="list-style-type: none"> a. Gram positives b. Gram negatives

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- c. Anaerobic infections
 - d. Mycobacterial
 - e. Atypicals, intracellular & fastidious organisms (Legionella, etc.)
 - f. Blood stream infections
 - g. CNS infections
 - h. Urine only
 - i. Not active in lung
 - j. Don't use for UTI
 - k. S. aureus & MRSA
 - l. Enterococcus & VRE
 - m. Streptococci including Beta hemolytics, S. pneumoniae & Viridans
 - n. Bioterrorism agents
 - o. Enteric GNR, NFGNR (e.g., P aeruginosa, etc.)
 - p. Haemophilus, Neisseria, GC, Chlamydia
6. Be familiar with the following methods for in vitro susceptibility testing and know why it is important to control the size of the inoculum, the contents of the media, the ion concentration, the length, atmosphere, temperature of incubation
 - a. Automated broth MIC
 - b. Broth MIC
 - c. Disk diffusion
 - d. Etest
 7. Be familiar with the following types of beta lactamases, their general genes types and location (chromosomal vs. plasmid), the bacteria in which they are commonly found, the antibiotics to which they confer resistance and the potential methods for detection and confirmation
 - a. ESBL
 - b. ampC
 - c. metallo Beta lactamases
 - d. KPC
 8. Be familiar with the following major Gram positive resistance phenotypes, the responsible genes if known, drugs to which they confer resistance, drugs that may be used to treat and methods of detection
 - a. MRSA
 - b. VRSA
 - c. VISA, hVISA
 - d. VRE
 - e. Penicillin resistance in S. pneumoniae
 - f. Inducible Clindamycin resistance in S. aureus, Beta hemolytic streps
 9. Review the recent resistance evolution for Neisseria GC, Salmonella typhi
 10. Familiarize yourself with the CLSI M 100 document & guidelines for MIC interpretation and testing
 11. Know the major drugs available to treat fungal infections, their

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

	<p>mechanisms of action and resistance and spectrum of activity</p> <ol style="list-style-type: none"> a. Azoles: Fluconazole, Itraconazole, Voriconazole, Posaconazole b. Echinocandins c. Amphotericin <p>12. Know which <i>Aspergillus</i> spp. are resistant to amphotericin, which <i>Candida</i> are resistant to azoles, echinocandins or amphotericin</p> <p>13. Know which drugs may be used for treatment of zygomycetes, fusarium and the dimorphic fungi</p>
Mycology	<ol style="list-style-type: none"> 1. Complete the 1 quiz / unknowns for this bench (Mycology). 2. Perform a scotch tape mount ≥ 5 times 3. Know corn meal morphology and key biochemical differences for <i>C. albicans</i>, <i>C. glabrata</i>, <i>Cryptococcus</i>, <i>Malassezia</i> spp. 4. Know <i>Candida</i> spp. with intrinsic or reduced susceptibility to azoles, amphotericin, and echinocandins 5. Know which drugs may be used to treat <i>Cryptococcus</i> 6. Be able to list main the drugs used to treat <i>Aspergillus</i>, <i>Fusarium</i>, <i>Pseudallescheria boydii</i>, and <i>Zygomycetes</i> and the main resistance issues between these groups 7. Discuss the potential clinical significance of isolation of various genera of mold or yeast from mucosal or respiratory sites including sinus, sputum, BAL, vagina, tissue or sterile body site 8. Be able to explain the different ways to diagnose invasive mold infection and the relative strengths and weaknesses of each method 9. Know how processing of tissues and other specimens for fungal culture is different than for bacterial cultures 10. Know the macroscopic and microscopic morphology (tease or scotch tape prep +/- histopath) for the following: <ol style="list-style-type: none"> a. Major yeasts b. <i>Aspergillus</i> including major species c. <i>Fusarium</i> d. <i>P. boydii</i> e. Dermatophytes f. Dimorphic fungi g. <i>Zygomycetes</i> h. Major dematiaceous molds 11. Describe the difference between hyalohyphomycetes and dematiaceous molds in culture 12. Know the major dimorphic molds, their geographic distributions, spectra of disease, methods of diagnosis, tissue appearance and methods for laboratory ID 13. Be familiar with the following clinical entities or terms: <ol style="list-style-type: none"> a. colonization b. superficial invasion c. actinomycosis d. mucormycosis vs. zygomycosis

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

	<ul style="list-style-type: none"> e. botryomycosis f. mycotic aneurysm g. madura foot h. black & white grain mycetoma i. eumycotic mycetoma vs. actinomycotic mycetoma j. chromoblastomycosis k. lobomycosis <ol style="list-style-type: none"> 14. Know the approximate growth rates for yeasts, dimorphs (varies), Aspergillus, other Hyalohyphomycetes, Zygomycetes, Dematiaceous molds, Dermatophytes 15. Make and read at least one calcofluor white stain (can be from culture) 16. Read about India ink, Cryptococcal antigen tests 17. Know which fungi can be detected in routine blood cultures, which require “fungal” blood cultures and which are not reliably detected from culture of blood by either method 18. Know the mechanism of action and spectrum of activity for each of the major antifungal drugs: Fluconazole, Itraconazole, Voriconazole, Posaconazole, Amphotericin B (Polyene), Echinocandins 19. Know the major clinical syndromes associated with aerobic actinomycetes, esp. Nocardia and distinguish “actinomyces” from “aerobic actinomycetes” 20. Know which aerobic actinomycetes are partially acid fast and which tissue stains may be used to detect them 21. Know the major tissue stains for fungi 22. Know the limitations of fungal ID from histopathologic sections and stains
Parasitology	<ol style="list-style-type: none"> 1. Complete the 1 quiz / unknowns for this bench (Parasitology). 2. Review the life cycles, modes of transmission, and natural history of disease for the major human parasites (textbooks and lab study materials) 3. Be able to recognize and identify the laboratory and, when appropriate, tissue morphology for the following <ul style="list-style-type: none"> a. Pathogenic and non-pathogenic protozoa b. Helminthes c. Tissue parasites d. Ectoparasites e. Blood parasites 4. Observe the processing or or process 5 stool specimens for O&P 5. Coordinate with a technologist to read \geq two negative and one positive O&P 6. Coordinate with the virology technologists to observe and review \geq 1-2 DFA for Cryptosporidium / Giardia, review the positive controls for these slides 7. Be able to describe the method(s) of specimen transport and processing for Stool O&P, DFA, & EIA methods 8. Be able to describe the timing and methods for collection and

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- processing of blood for the detection of malaria, trypanosomes & microfilariae
9. Be able to list and discuss the relative strengths and weaknesses of the various methods that may be used for the diagnosis of parasites including sensitivity, specificity and availability. Know which parasites will and will not be detected by each method and the relative sensitivities for various parasites and disease states.
 - a. Microscopic O&P (wet mount, iodine prep, trichrome)
 - b. Special stains
 - i. Modified AFB
 - ii. Calcofluor
 - iii. Gram chromotrope
 - c. Immunoassays for antigen detection
 - d. Serology
 - e. PCR
 - f. Stained Blood films
 - g. Acridine orange
 10. Be able to state the preferred specimen and test method and alternatives for the detection of each of the following
 - a. Giardia
 - b. Cryptosporidium
 - c. Entamoeba histolytica/dispar
 - d. Dientamoeba fragilis
 - e. Blastocystis hominis
 - f. Cyclospora
 - g. Isospora
 - h. Microsporidia
 - i. Strongyloides
 - i. Intestinal
 - ii. Disseminated
 - j. Amebic liver abscess
 - k. Malaria
 - l. Trypanosomes
 - m. Microfilaria
 - i. Tissue
 - ii. Blood
 - n. Echinococcus
 - o. Miscellaneous Helminthes
 - p. Pinworms
 11. Be able to explain the difference between E. histolytica and E. dispar and how these may be distinguished in clinical specimens
 12. Be able to discuss the significance of E. coli, D. fragilis, B. hominis, and G lamblia from stool
 13. Know the epidemiology / causes of infectious gastroenteritis in the US and in travelers from underdeveloped regions including the relative proportions of disease that are caused by viruses, bacteria and

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

	<p>parasites</p> <p>14. Know which parasites are associated with Eosinophilia</p>
<p>Virology</p>	<ol style="list-style-type: none"> 1. Complete the 1 quiz / unknowns for this bench (virology). 2. Be able to list and discuss the strengths and weaknesses of all the potential ways (methods) to detect viruses 3. Participate / observe in the set up or reading of EIA, DFA, Cell cultures (Shell vials & tube cultures) 4. Be able to discuss the associated disease states, methods available for the detection and relative strengths and weaknesses of each test method (e.g., DFA vs Culture vs PCR vs Serology) for the following viruses <ol style="list-style-type: none"> a. DNA viruses <ol style="list-style-type: none"> i. Herpesviruses <ol style="list-style-type: none"> 1. HSV 2. VZV 3. CMV 4. HHV-6 5. EBV 6. HHV-8 ii. Adenoviruses iii. Papova viruses <ol style="list-style-type: none"> 1. HPV 2. Polyoma viruses iv. Parvoviruses v. Hepadnaviruses (HBV) vi. Pox viruses <ol style="list-style-type: none"> 1. Smallpox (Varioloa) 2. Molluscum contagiosum vii. Polyoma viruses b. RNA viruses <ol style="list-style-type: none"> i. Orthomyxoviruses <ol style="list-style-type: none"> 1. Influenza ii. Paramyxoviruses <ol style="list-style-type: none"> 1. Parainfluenza 2. RSV 3. Measles 4. Mumps 5. hMPV iii. Coronaviruses <ol style="list-style-type: none"> 1. SARS 2. HC 229E, OC43, etc. iv. Picornaviruses <ol style="list-style-type: none"> 1. Coxsackieviruses 2. Echoviruses 3. Enteroviruses 4. Polioviruses

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

- 5. Rhinoviruses
- 6. HAV
- v. Caliciviruses
 - 1. Norovirus
- vi. Reoviruses
 - 1. Rotavirus
- vii. Astroviruses
- viii. Filoviruses
 - 1. Marburg
 - 2. Ebola
- ix. Arenaviruses
 - 1. LCM
 - 2. Lassa
 - 3. Machupo
- x. Flaviviruses
 - 1. Yellow fever
 - 2. Dengue
 - 3. WNV
 - 4. JEV, St Louis EV
 - 5. HCV
- xi. Retroviruses
 - 1. HTLV
 - 2. HIV
- xii. Bunyaviruses
 - 1. Hanta
 - 2. Rift valley fever, Crimean congo virus
- xiii. Rhabdoviruses
 - 1. Rabies

- 5. Know the common types of traditional cell types used for culture of Herpesviruses, paramyxoviruses and enteroviruses.
- 6. Discuss the viruses that can be detected in culture and which ones are not generally cultivable.
- 7. Be able to discuss the significance of a positive qualitative PCR result for EBV, CMV or HHV-6 from blood, tissue, or CSF
- 8. Be able to list the methods available to help interpret the significance of a positive qualitative PCR for one of the above
- 9. Know the drugs available to treat Influenza and herpesviruses and their mechanisms of action
- 10. Know the common H & N types for seasonal vs. potential pandemic flu strains (avian, etc)
- 11. Be able to explain the difference between antigenic shift and drift in the epidemiology of Influenza
- 12. Understand the reasons why animal including avian strains may have limited ability to be transmitted from human to human
- 13. Discuss the theoretical issues related to detection of pandemic influenza

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

	<p>by current laboratory assays.</p> <p>14. Know the common viral causes of upper and lower respiratory tract disease</p> <p>15. Know the differences between HSV 1 & 2 relative to transmission, typical and emerging locations of primary lesions and manifestations of meningitis</p> <p>16. Know the common viral causes of infectious diarrhea</p> <p>17. Know the main groups and viruses known as the “hemorrhagic fever viruses”</p>
<p>Serology & Antigen Detection</p>	<ol style="list-style-type: none"> 1. Complete the 1 quiz / unknowns for this bench (Serology / Antigen detection). 2. Be familiar with the following diseases for which serology is a major component or the only means of diagnosis <ol style="list-style-type: none"> a. HIV b. Hepatitis viruses <ol style="list-style-type: none"> i. HAV ii. HBV iii. HCV c. WNV d. Other arthropod borne encephalitis viruses e. Hantavirus f. Lyme disease g. Poststreptococcal disease (ASO, Dnase B) h. Brucellosis i. Coxiella burnetti j. Bartonella k. Chlamydia pneumoniae l. Mycoplasma pneumoniae m. Syphilis (T. pallidum) n. Coccidioides o. Blastomyces dermatitidis p. Histoplasma capsulatum q. Strongyloides r. Entamoeba histolytica s. LGV serovars of Chlamydia trachomatis t. Herpesviruses <ol style="list-style-type: none"> i. HSV ii. EBV iii. CMV iv. HHV-6 3. Be able to describe the difference between EIA, western blot & IFA 4. Know the criteria for calling an HIV or Lyme WB positive or negative 5. Discuss the significance and follow up options for an indeterminate HIV WB 6. Know the role and current indications for RIBA testing in the diagnosis

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

	<p>of HCV</p> <ol style="list-style-type: none"> 7. Know the sequence of development of antibodies and / or antigens in EBV, HBV, HCV 8. Know the timing of detection of viremia, p24 antigenemia and development of antibodies for HIV. Know the meaning and approximate lengths of the “window period” depending on the type of HIV test being used for diagnosis. 9. Know how to diagnose HIV and Syphilis in newborns 10. Discuss the testing issues and potential follow up for pregnant females with positive Toxoplasma IgM 11. Discuss the value of routine torch testing 12. Know the bacteria and fungi for which antigen detection is available from urine and the relative performance of this method vs. other methods (e.g., serology, culture)
<p>Mycobacteriology- Sac Co PHL</p>	<ol style="list-style-type: none"> 1. Complete the 1 quiz / unknowns for this bench (Mycobacteriology) . 2. Be familiar with the common forms of disease, patient populations at risk, growth rate, pigmentation and key biochemical features for the following mycobacteria <ol style="list-style-type: none"> a. M. tuberculosis (know that TB is actually a complex including M bovis & bovis BCG) b. M abscessus, chelonae, fortuitum c. M. scrofulaceum d. M avium intracellulareae e. M marinum f. M kansasii g. M gordonae 3. Know how & why the kinyoun and auramine orange stains work and why these are relatively specific for Mycobacteria 4. Know what MTB looks like on smears and in culture 5. Briefly review the different media types used in the detection of Mycobacteria and both their nutritional & inhibitory components 6. Know why & how non-sterile samples submitted for mycobacterial culture are processed and decontaminated prior to stain and culture 7. Be aware of the molecular tests available for direct detection of MTB from respiratory and CSF samples and the molecular probes used for rapid confirmation of ID from positive culture 8. Know the approximate time to detection for MTB, slow growers (including MAI) and rapid growers from broth and solid media 9. Know the drugs used to treat MTB, MAI, and the rapidly growing mycobacteria 10. Know the unique resistance profile associated with M bovis 11. Know the epidemiology of M bovis disease in the community and due to prior therapy for bladder cancer 12. Be familiar with the differences between the PPD and the interferon gamma release assays, the processing limitations associated with the later and the potential reasons why these assays may replace the PPD

DEPARTMENT OF PATHOLOGY AND LABORATORY MEDICINE

	in the future
Specialist bench Procedure revision or validation	<ol style="list-style-type: none">1. Identify one basic procedure (SOP) in need of review and complete revision or draft during this bench rotation (see above).2. Review and work through the masterlog one time on this bench with one of the specialists.3. Assist the specialists daily with any issues or calls that are active on the bench.4. Review 5-10 culture result slips daily that were not negative and then review with specialist or supervisor5. Be able to discuss the potential impact that differences in volume, temperature or delay in transport, type of specimen or transport media may have on the value or yield of microbiology testing.6. Read the recommended sections in the Microbiology Cumitech on maintaining competency in the microbiology laboratory.7. Be able to list at least 3-5 ways in which sensitivity of culture, accuracy of biochemical tests, ID, susceptibility, & overall culture results are monitored and maintained both immediately and over time.8. Discuss the workflow demands in the microbiology lab related to specimen processing and timeliness of results and the potential clinical impacts associated with lack of 24 hour, evening, or weekend coverage.9. Discuss the daily, weekly and monthly QC performed in the micro lab with a specialist or designee.10. Discuss the importance of equipment maintenance and checks for temperature, CO2 or anaerobic environment, media sterility, BSC function, etc.11. Be able to discuss some of the issues related to quality control regarding detection of organisms from real clinical samples vs. QC bugs and to the detection and testing of living organisms in general12. Discuss some of the unique issues related to PT for microbiology and in particular parasitology.

References:

1. Koneman's Color Atlas & Textbook of Clinical Microbiology, 6th Ed.
2. Smith BR, et al., Curriculum Content and Evaluation of Resident Competency in Clinical Pathology (Laboratory Medicine): A Proposal. *Clin Chem* 2006